UNIVERSITY OF ARKANSAS

COLLEGE OF AGRICULTURE

Agricultural Experiment Station

IMPERIAL BUREAU OF MYCOLOGY
30 JUN. 1921

A BACTERIAL ROOT-ROT OF FIELD CORN

BULLETIN NO. 162

(TECHNICAL)

FAYETTEVILLE, ARKANSAS
AUGUST, 1919

The Bulletins of this Station are sent free to all residents of the State who request them.

UNIVERSITY OF ARKANSAS

AGRICULTURAL EXPERIMENT STATION

BOARD OF TRUSTEES

Governor Charles H. Brough, *Chairman*

Hon. J. K. Mahony
Hon. H. L. Ponder,
Hon. Frank Pace,
Hon. J. L. Bond,
Hon. Z. L. Reagan,
Hon. A. B. Banks,
Hon. J. D. Head,
Hon. J. K. Browning,

W. H. Cravens, *Secretary*

BOARD OF CONTROL

Committee on Agricultural College, President of the University, Director of the Station.

STATION STAFF

J. C. FUTRALL, President of the University
MARTIN NELSON, Director of the Station

W. J. Baerg---Entomologist
Wm. L. Bleecker---Bacteriologist
J. R. Cooper---Horticulturist
H. E. Dvorachek---Animal Husbandman
J. A. Elliott---Plant Pathologist
R. M. Gow---Veterinarian
Martin Nelson---Agronomist
Stella Palmer---Home Economics
W. J. Read---Agricultural Chemist
R. H. Austin---Assistant Agronomist
Ruth Cowan---Assistant Home Economics
Ruth O. Dyche---Assistant Home Economics
Jean Hill---Assistant Home Economics
E. A. Hodson---Assistant Agronomist
R. A. Hunt---Assistant Animal Husbandman
R. H. Mason---Assistant Animal Husbandman
L. W. Osborn---Assistant Agronomist
R. H. Ridgell---Assistant Agricultural Chemist
J M. Roberts---Assistant Horticulturist
H. R. Rosen---Assistant Plant Pathologist
W. H. Sachs---Assistant Agronomist
S. R. Stout---Assistant Animal Husbandman
J. E. Syferd---Assistant Veterinarian

Correspondents should notify the Director of any change in post office address, or failure or delay in receiving bulletins.

MARTIN NELSON, *Director.*

Fayetteville, Arkansas.

A BACTERIAL ROOT-ROT OF FIELD CORN

H. R. ROSEN

A serious disease of field corn has recently been detected by the writer about which but little information is available. Although the disease has been known since 1889 and has been recognized in a number of states, Illinois by Burrill (1889,) Nebraska by Billings (1889,) Indiana and Maryland by Moore (1886,) Ohio by Selby (1910,) Tennessee by Essary (1917,) and New Jersey by Cook (1918,) the cause of it has remained obscure up to the present. The disease manifests itself as a serious rotting of the roots and of the portion of the stalk to which they are attached. (See *Plate* 1.) The specimens came from the farm of E. B. Whitfield, located near Beauxite, Saline County, Arkansas. The roots presented a compact, matted appearance with no elongated feeding roots such as healthy corn plants possess. Individual roots showed brownish dead areas especially on the parts immediately joining the stem.

The most characteristic feature of the disease was observed when the stalk was cut in half through its long axis. The lower nodes or joints to which the roots are attached showed a marked, purplish-brown discoloration on the cut surface while the internodes or the spaces between the joints preserved their normal, white color. The extreme base of the stalk was similarly discolored, the brownish area extending up an inch or two. This tissue was either dead or in a process of disintegration and from it a pure culture of a bacterial organism was obtained.

The method employed in isolating the pathogen was as follows. By using a scalpel, sterilized by heating over a flame, bits of the brownish tissue were cut from the interior of the stalk. These were placed in a tube of sterile tap-water and macerated by means of a sterilized rod. Dilutions were made by removing about 0.1 cc of the water containing the broken up tissue to another tube containing about 15 cc of sterile water. This was further diluted by removing a small quantity from the second tube to a third tube of water. The ordinary poured-plate method was followed, using a peptone-beef-agar as the medium. In 48 hours small, whitish bacterial colonies appeared on all the 10 plates. Their round shape and color, together with the frequency of their appearance, immediately marked them from other growths of inconsequential number. Some plates showed no other organisms present.

In order to prove the pathogenicity of this organism a needle smear from a 48 hour culture taken from an agar slant was applied to a young root which had sprouted from a corn kernel growing in a test tube of beef agar. Within 48 hours the cortical portion of the root to which the organism was applied was brown and dead (see *Plate* 2) while the check roots to which no organism had been applied were white in color and sound throughout. Inoculated root-tips were killed and the diseased spots might be traced along the roots to the stem. From the brown, dead tissue, which was surface sterilized, the organism was reisolated and obtained in pure culture.

A study of the disease as it appeared in the field was made by the writer and photographs were taken illustrating its manner of appearance. The variety of field corn attacked goes by the local name of *gamble*. It had been grown by Mr. Whitfield for about 7 years and has been a favorite in that section of Arkansas for a large number of years. It is a good yielder, frequently producing 2 to 3 well filled ears to the stalk. The corn was growing on a very light, sandy soil on land which was slightly rolling. Previous to 1914 this piece of and, about 7 acres in size, was an abandoned field which was occupied by a second growth of native short-leaved pine. The crops grown on it, starting with 1914, are corn, oats, corn, corn, cowpeas and corn. The *gamble* variety of corn only was used and seed was saved from year to year. In spite of the very sandy nature of the soil the corn grew 12 to 14 feet high and gave good yields. The healthy, normal corn had attained this height when the field was visited by the writer on July 30.

The disease was especially noticeable in two considerable sized patches, although diseased stalks were to be seen more or less scattered throughout the field. It was easily recognized by the short, stunted nature of the stalks, by the slightly lighter-colored or partially withered appearance of the foliage and by the extreme ease with which these plants could be pulled from the ground. The brown and dead roots and the internal browning at the base of the stem, mentioned at the beginning of this article, were to be be seen on all affected plants. Some of the hills in the two patches, previously noted, were missing and the diseased plants stood 1 to 6 feet high bearing no ears or very small, undeveloped ones. *Plate* 3 shows diseased stalks alongside of an average sized, healthy one, and *Plate* 4 shows a portion of a diseased patch. Besides the ordinary corn rust, which was rather scarce, the only other diseased condition noted was a dark brown spotting of husks, leaf blades and leaf sheaths. It is possible that this represents a type of secondary injury due to the pathogen which is responsible for the root-rot; investigations of this injury are being conducted. It may be mentioned

that aphids have been found associated with some of these spots, which may act as carriers of the disease producing organism; also that small purplish-brown spots resembling the spots found on plants growing in the field, have been produced by artificial inoculation with the organism causing the root-rot.

A study of the literature of this disease reveals that it is hardly understood and that little accurate work has been done on it. It was first observed in Illinois by Burrill (1889) who describes symptoms very much like the ones presented above, and who associated a bacterial organism with the disease. With pure cultures he was able to produce spots on the leaves but obtained no root infections in spite of special efforts to do so (see Billings.) His description of the reisolation of the organism is rather vague. Altogether, the work of Dr. Burrill does not convince one that he had isolated the true pathogen. Dr. Smith (1914) questions whether there is such a disease, being inclined to believe that it is due to *Bacterium Stewarti*, which is a vascular disease producer of sweet corn. But Smith notes in Burrill's disease the total absence of any yellow ooze in the bundles, a very characteristic syptom of Stewart's disease, seen when the stalk is cut crosswise, and is therefore unable to come to any definite conclusion regarding the disease producer. Undoubtedly Dr. Smith was justified in refusing to recognize this as a distinct disease since the culture which Dr. Burrill forwarded to him as the true pathogen of corn was identified by Dr. Theobald Smith (1893) as *Bacillus cloacae* Jordan. This latter organism is a sewage and water frequenter and is described as a peritrichiate rod. Hoffer and Holbert (1918) found bacteria as well as *Fusarium*, causing a rot of root tips of surface sterilized kernels growing in flasks and in another publication (1918) mention a *Pseudomonas*, along with several fungi, which produce corn root-rots.

No attempt will be made to establish a name for this organism at present. It should be pointed out that the organism is actively motile and possesses a single polar flagellum, observed by using Pitfield's flagella stain. The writer wishes to call attention to a reddish spot of corn leaves produced by artificial inoculation with a bacterium obtained from foxtail spots, (Rosen 1919.) Infections with the root-rot organism have been produced on oats, yielding yellowish-brown spots; from these artificial inoculations on oats the organism has been reisolated. Mention should also be made of a white bacterium isolated by the writer from brownish spots on corn leaves which may prove to be the same as the foxtail organism. Ie remains to be ascertained whether the organisms isolated by the writer from foxtail, corn roots, and corn leaves are all one and the same species. While Dr. Burrill made the statement that the corn organism was different from the one producing the root-rot and leaf spotting of

sorghum it remains to be determined whether this is true. The extreme prevalence of sorghum blight at Mr. Whitfield's farm and the striking similarity of symptoms on the two different hosts, plus the preliminary culture and infection experiments of the writer point to a conclusion different from that expressed by Dr. Burrill.

BIBLIOGRAPHY

(1889) BURRILL, T. J. A bacterial disease of corn. Univ. Illinois, Agr. Exp. Sta. Bul. 6.

(1889) BILLINGS, F. S. The cattle diseases in Nebraska. II The corn stalk disease in cattle. Nebraska Agr. Exp. Sta. Buls. 7, 8, 9 anl 10.

(1893) SMITH, THEOBALD. The fermentation tube. Wilder Quarter Century Book pp. 187-232.

(1896) MOORE, V. A. Cornstalk disease and rabies in cattle. U. S. Dept. Agr. Bur. Anim. Ind. Bul. 10.

(1910) SELBY, A. D. A brief handbook of the diseases of cultivated plants in Ohio. Ohio Agr. Exp. Sta. Bul. 214.

(1914) SMITH, E. F. Bacteria in relation to plant disease. 3:147.

(1917) Essary, S. H. Bacterial root-rot of corn. Bul. of Plant Disease Survey No. 3 Sept. 15. p. 52.

(1918) COOK, M. T. Diseases of grains and forage crops. New Jersey Agr. Exp. Sta. Circ. 102.

(1918) HOFFER, G. N. and HOLBERT, J. R. Results of corn disease investigations. Science n. s. 47:246-247.

(1918) HOFFER, G. N. and HOLBERT, J. R. Selection of disease free seed corn. Purdue Univ., Agr. Exp. Sta. Bul. 224.

(1919) ROSEN, H. R. A preliminary note on a bacterial disease of foxtail. Science n. s. 49:291.

EXPLANATION OF PLATES

Plate 1.—Upper photograph—a basal portion of a diseased stalk cut in half showing the cut surface in one and the outside surface in the other. Note the discoloration at the nodes and at the extreme base of the stalk in one half and the matted appearance of the roots with dark brown discolorations where they join the stem in the other half.

Lower photograph—an enlarged view of the cut surface shown in upper photograph.

Plate 2.—The tube on the right shows a darkened, shriveled portion of a root with the root-hairs killed—the result of artificial inoculation. Compare with check tube alongside of it.

Plate 3.—Comparison between a normal, healthy stalk, in the center, and diseased plants on both sides of it.

Plate 4.—A view of a portion of a diseased patch. Note the missing hills and the undersized plants in the foreground.

PLATE 1

PLATE 2

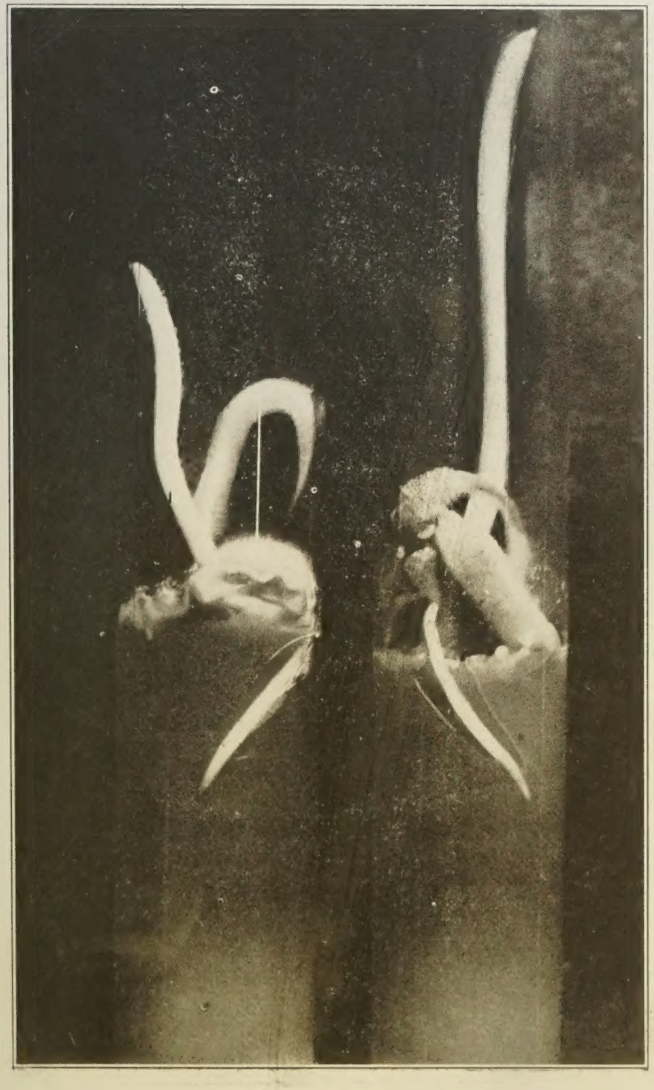

PLATE 3

PLATE 4